Volume 14 September, 1928 *Number 9*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

The Cost of Lubrication

Being a Study of
Lubrication Problems and
Their Correction

PUBLISHED MONTHLY BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

Unfamiliar Languages

But One Familiar Word:—

TEXACO

Sail down the China Sea from Hong Kong to the shores of India—across to South Africa—back to the Antipodes —over the length and breadth of the Eastern Hemisphere.

Wherever you go, the Red Star with the green "T" bearing the name TEXACO—awaits you.

Texaco petroleum products lubricate great industries in Europe—keep wheels of transport and machinery of agriculture turning freely in far off China, India, Australia, Africa and New Zealand And TEXACO Gasoline and Golden Motor Oils are accepted by motorists as the Standard of quality everywhere.

So go where you will throughout these countries of unfamiliar languages —one familiar word will greet you— TEXACO—and the TEXACO Star— symbol of quality in petroleum products

TEXACO

PETROLEUM PRODUCTS

THE TEXAS COMPANY

Dept. H, 17 Battery Place, New York City

OFFICES IN PRINCIPAL CITIES

LUBRICATION

A Technical Publication Devoted to the Selection and Use of Lubricants

Published Monthly by

The Texas Company, 17 Battery Place, New York City

Vol. XIV September, 1928 No. 9

Change of Address: In reporting change of address kindly give both old and new addresses.

The Cost of Lubrication

Being a Study of Lubrication Problems and Their Correction

THE cost of lubrication is an item in power and industrial plant operation which is coming more and more to be considered. For the thoughtful executive has realized that it is not entirely confined to initial cost of lubricating oils and greases, their means of application and the labor attendant thereto. Excessive maintenance and repair expense due to thoughtless selection of improper lubricants, faulty lubricating equipment or negligence must justly be regarded likewise as a cost chargeable to the lubricating account.

In consequence a study of the means and methods of bringing about reductions in maintenance and repair must be given serious consideration. Initial cost of lubricants, lubricating equipment and the labor involved in application will be relatively stable. But the cost of upkeep in the maintenance of bearings, gears and chains, etc. in proper condition to function efficiently may vary widely. Effective lubrication is insurance in this regard, it is the secret of minimum friction, reductions in wear and dependable operation of machinery as a whole. It is furthermore a most decided factor in the maintaining of production schedules.

HOW PRODUCTION IS AFFECTED

Production will naturally depend to a great extent upon keeping machinery running. There is no more prevalent cause for cessation of operation than imperfect or insufficient lubrication. As a result, in view of the fact that the management is responsible for production, naturally their interest should be centered quite as keenly upon the operating feature which will insure this; viz.: Plant Lubrication.

We can all remember when this latter simply consisted of applying the lubricants, and the greater the volume used the more effectively did we hopefully believe the plant was running. But this has been disproved. Today conservation of lubricants, and decrease in costs of maintenance and labor must be considered. In consequence the science of lubrication has come into existence, and the study of lubricating problems has become as equally important as the study of power economy, the usage of steam and the conservation of heat or mechanical energy.

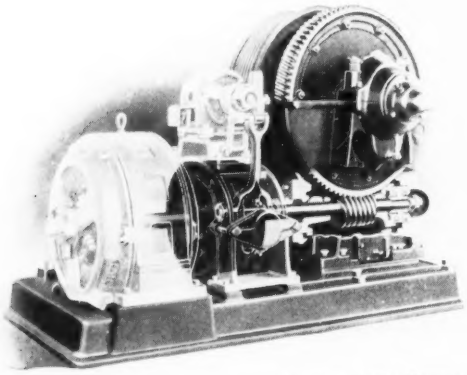
There is a direct tie-up between lubricating problems and cost of maintenance and repair, for if the former are not solved by judicious selection and proper application of lubricants suited to the operating conditions involved, the latter cannot be dependably controlled. In other words regardless of how efficient a lubricating system may be, if the lubricant is not suited for the purpose, or if it has been stored and handled in a sloppy manner and allowed to become contaminated with dirt or other foreign matter, there will always be danger of overheating of bearings, etc., or excessive wear.

The results to be expected from such operation will be, machine break-down sooner or later; increased repair bills and a decrease in output in proportion to the importance of the equipment in question and the part which it plays in the production schedule.

The Value of Research and Publicity

It is strange that so many have had to be educated in this matter of lubrication. The advantages should be self-evident. But such

has been the case and hence manufacturers of lubricants and builders of lubricating equipment have devoted their efforts untiringly, and expended huge sums in extensive research, and educational and publicity campaigns. For they have had to overcome that "show me" attitude



Courtesy of Otis Elevator Co.

Fig. 1—Phantom view of the drive of an electric driven type of elevator showing in detail the relative positions of worm and gear, and the essential bearings.

so prevalent in many industries. In fact, even in the face of both theoretical and practical proofs, the user of lubricants has often been found to remain skeptical, in his belief that "oil is oil," and enough of it applied is all he need worry about.

Very often, even executives, trained in the principles of engineering and regarded as authorities in their profession will state point blankly that the science of lubrication is relatively "bunk." There are even some who will be prone to blame the lubricating oil in event of any machine failure, though they will maintain a stoic attitude of indifference as to why the lubricant should have caused this. It is in their plants that the cost of lubrication is usually high.

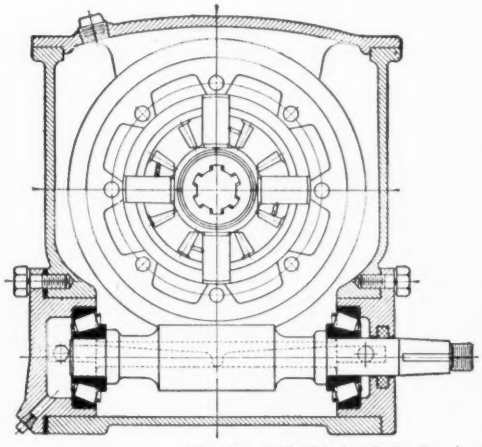
For, to state that there is an oil for every purpose, etc., is not merely advertising propaganda; it truly means what it says, and is backed by years of research and millions expended. As a result, it is folly for the skeptic to maintain an attitude of seeming indifference. He would not ignore the development of new types of machinery adapted to his class of work, so why should he ignore the vital factor that keeps them running? He need only try a heavy gear oil or a cheap grade of red engine oil on the bearings of a high speed turbine, or on the spindles of a textile machine, to quickly discover that an idea that "oil is oil" is decidedly obsolete.

The Executive Must Cooperate

The industrial and power plant executive must therefore keep pace with the science of lubrication just as the latter has kept pace with industrial and machine development, if maximum production is to be maintained with minimum operating costs. Furthermore, he must realize that it is scientific research, not advertising propaganda, which dictates that there is probably a grade of lubricant suited for each and every phase of operation, by virtue of its characteristics.

In order to obtain this ultimate maximum of efficiency in the usage of lubricants, however, it is essential at all times that there be the utmost cooperation between plant executives and engineers, and the lubricating experts representing the oil industry. For this reason it is advisable, where the volume of lubricants concerned will warrant, to employ a lubricating engineer whose duties should be the supervision of plant lubrication. He should preferably be a technical man, familiar with machine details and lubricating equipment, conversant with the usual grades of lubricants on the market, and able to plan and carry out intensive experimental work whenever necessary.

To further such efficiency as mentioned heretofore, the petroleum industry is continually devoting much time and study to the development of lubricants which will be adapted in every characteristic to the service they are intended to perform. Naturally a multitude of conditions must be taken into consideration in this work due to the fact that many plants will operate similar machines quite differently, and grades of lubricants that would be suitable to one might fail in another due essentially to such



Courtesy of The Timken Roller Bearing Co.

Fig. 2—Sectional view of a worm gear drive showing application of tapered roller bearings to the worm shaft

elements as excessive heat, water, acids or other chemicals.

On the whole it is a broad subject, but one wherein cooperation will solve many of the minor problems, and so govern matters that the seriousness of the larger problems will be

reduced to a marked degree, with decidedly favorable reaction upon the cost of lubrication.

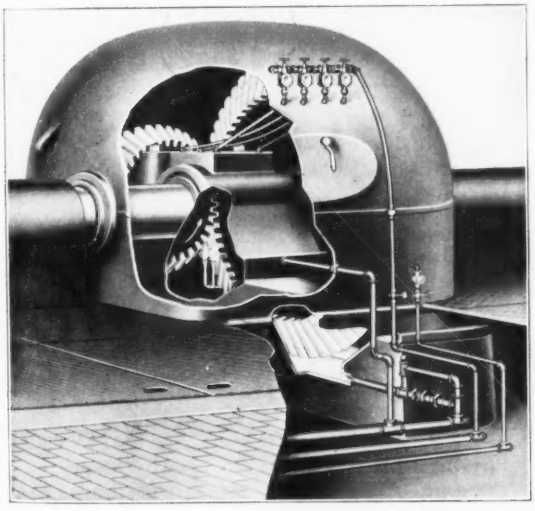
STUDY OF THE PROBLEMS INVOLVED

Lubricating problems can in general be said to largely depend upon the care with which the lubricants have been originally selected and the intelligence of the operators who have to do with their storage, handling and application.

Relative to the care observed in the selection of lubricants, it may be stated that the degree to which this may be necessary will in turn depend upon the reliability of the source from which the products are purchased. If bought from a company of recognized integrity, furnishing engineering service and technical advice to its customers, the possibility of its products becoming involved in difficulties will be far less than where lubricants are bought by the users according to their own ideas. Hence the value of lubricating engineering service, the purpose of which is to increase machine efficiency and production to a maximum by the elimination of lubrication problems wherever possible.

Worm Gear Drives

It will be interesting to go into detail in regard to certain of the more common problems which may be encountered in the lubrication of large industrial plants. For example, take the



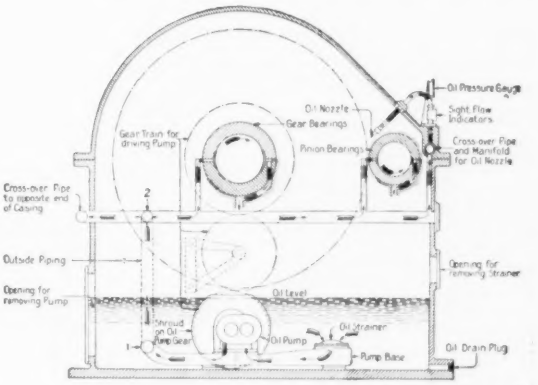
Courtesy of S. F. Bowser & Co. Inc.

Fig. 3—Showing means for automatic lubrication of bevel gears. Flood lubrication under positive control is a decided asset in the protection of gears and bearings.

hoisting mechanisms in the average freight elevator. Usually such machines are of the electric drum type being motor driven, through a worm reduction gear by means of which the speed of the motor is suitably reduced to give the proper speed to the hoisting drum.

The essential problem in operating such a mechanism is to lubricate the worm and gear so that the minimum starting and running torques will be developed irrespective of operating temperatures or other conditions.

As a general rule it is conceded that the



Courtesy of General Electric Co.

Fig. 4—Lubrication system for steam turbine reduction gears, where pinion is subject to counter-clockwise rotation. Direction of oil flow is indicated by arrows, all parts being clearly shown.

lubricant for such service should be approximately of the same consistency as a medium steam cylinder oil; having a viscosity in the neighborhood of 120 to 150 seconds Saybolt, at 210 degrees Fahr. The chief requirement is sufficient body to resist the relatively high pressures exerted at the points of contact of the gear teeth and worm, especially when starting under heavy loads. This will adequately prevent actual metal to metal contact and the possibility of abnormal wear.

Lubricants Available

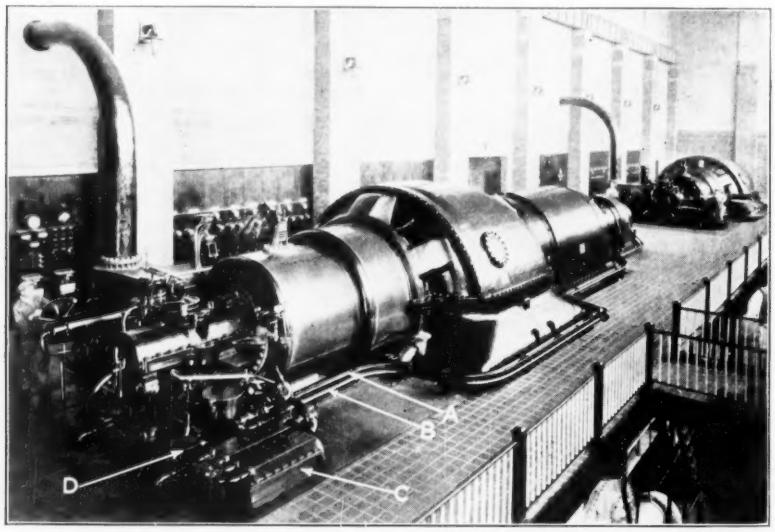
A variety of lubricants are available for such service varying from the straight mineral, steam refined cylinder oil stocks, down to certain light grease compounds or mixtures of cylinder oils with vegetable or fish oil. Each may involve its own particular problems according to the manner in which it has been refined or compounded, or the temperature of the gear case.

Compounds of Animal Fats May Develop Acidity

For example, with a lubricant containing a fixed oil compound such as fish oil, etc., a high degree of acidity might be developed to result in rapid corrosion of the metallic gear surfaces, or the roller or ball thrust bearings. Again, if a gear grease is used, unless compounding has been carefully carried out, there might be a tendency towards separation of the oil and soap constituents with the result that the gear and worm would be subject to rapid wear, especially where the petroleum constituent is a light oil, and without sufficient body to insure prevention of metallic contact.

Castor Oil Compounds

Where castor oil is included in a worm gear lubricant it is important to understand that the lubricating ability of this oil may be materially affected by the process of compounding. Castor oil is not ordinarily soluble in petroleum oil; as a result, to bring about a mixture certain processing is necessary, or a third oil is used, which serves the purpose of a blending reagent. But such treatment may affect the constitution of castor oil and render it decidedly susceptible to chemical change.



Courtesy of Allis-Chalmers Mfg. Co.

Fig. 5—A steam turbine installation showing relative size of oil piping, pump and cooler. "A" indicates the main oil supply line to bearings; "B" the oil return pipe; "C" the oil cooler and "D" the Auxiliary oil pump.

In some instances a lubricant so compounded may become so sluggish at low temperatures as to give rise to abnormally high starting and running torques especially where the elevator hoisting mechanism is located at the top of a shaft and exposed to appreciably low atmospheric temperatures.

It is obvious therefore, that there are many factors which must be investigated by the management in selecting a worm gear lubricant. All the above mentioned lubricants may serve the purpose admirably under operating conditions suited to their constituents, and still present serious difficulties at certain times.

High Speed Bearings

The steam turbine affords another frequent source of lubricating problems. It would seem that inasmuch as bearings alone are involved, turbine lubrication would be relatively simple. In fact, as one executive once remarked "All we need is to feed good oil to the bearings in sufficient quantities and cleanse the system now and then and things will run smoothly." Yet when the power plant was suddenly forced to shut down because of a burned out bearing, he could not imagine the cause and was tempted to blame the erectors for misalignment of bearings.

The real cause, however, was due to his idea that the oil only needed to be cleansed "now and then." As a result he did not think that a reputable oil reclamation system was worth the expense. Instead a rough homemade filter and settling tank was used, into which approximately half the oil from the turbine sump was dumped at very infrequent intervals. Due furthermore, to his idea of economy from a time point of view this oil was only allowed about half the period for purification that such a device would usually require. In consequence considerable of the lighter entrained sludge, etc., was forthwith dumped back into the oil sump.

When the turbine bearing caps were removed during the course of repairs, the cause of the trouble was immediately obvious for the oil ways were found to be practically clogged with foreign matter, and one oil pipe was virtually plugged.

Oil Purification a Vital Factor

All this occurred needlessly, for the management had been warned of conditions by a capable lubricating engineer. Still, they disregarded his suggestions and followed out their own way, with the result that production practically stopped over the period of repairs to the turbine. Here was a typical example of where even the best of oils may fail if improperly handled or applied; or, if reasonable precautions are not taken for the protection of lubricating ability and assurance of free circulation.

GEAR PROBLEMS

Gear lubrication in certain industries is frequently another problem. Especially will this be true in plants where fragile or perishable goods are produced such as in the textile industry, the baking or the flour milling trades. Here the accidental dripping or throwing of the lubricant onto the products at any stage of their manufacture may cause serious damage, or even ruin.

In the Flour Mill

In the flour mill certain of the apparatus is gear and chain driven, with much of this mechanism in close proximity to the flour in its passage through the mill. Should the lubricant be too light with a tendency of dripping, or not sufficiently adhesive, or should it be so heavy as to ball up on the gear teeth and be thrown off by centrifugal force serious contamination of the flour might result.

In the Bakery

In the baking industry also, the dough mixers often involve reduction gearing as part of the driving mechanism. Here again there is the ever prevalent possibility of the products becoming contaminated if improper gear lubricants are used or a careless method of application is employed.

For this reason, as well as to insure the safety of the operators the gears should be encased, and open drives should be eliminated whenever possible. But little of a compound such as the average gear lubricant will be required, to practically ruin a batch of dough, and with unguarded gears when the dough is removed from the mixer for subsequent treatment, a wad of it might very easily touch the gears unnoticed. Obviously the presence of gear lubricant in the subsequent loaves of bread would not react favorably upon the baker in question.

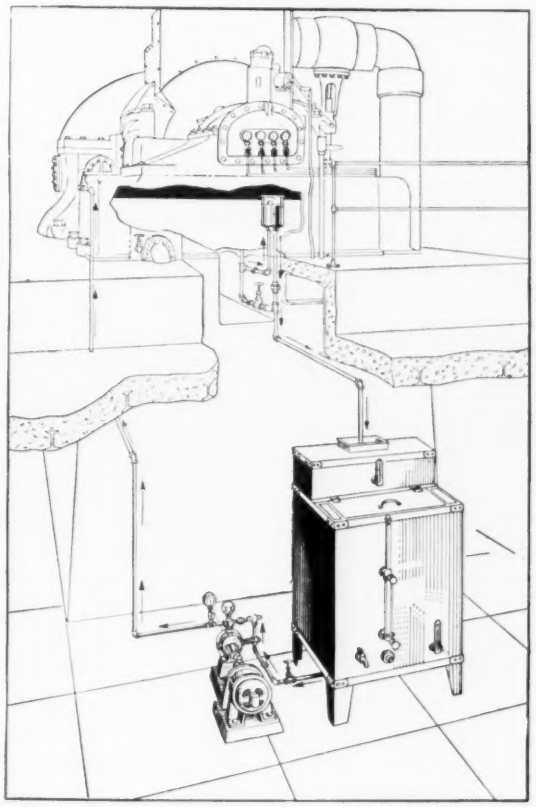
Rubber Mill Gears

Gear lubrication in the rubber industry is also of material importance, by reason of such adverse operating conditions as the presence of dust from the compounds used, and the relatively high pressures that are employed on certain of the roller mills. As a result lubricating problems may frequently arise.

Pressure and Dust Must Be Considered

It has been developed that pressure and dust together present conflicting requirements in a gear lubricant, to render attainment of effective lubrication a difficult matter. For example, where dust is present a lighter grade of lubricant should be used since it will lubricate better and last longer than a heavier compound which would tend to ball up or be thrown off by centrifugal force in a relatively short space of time after becoming sufficiently mixed with dust. In contrast, gears subjected to high pressures require a heavy, adhesive compound that will adequately resist the squeezing action of the gear teeth, and insure that a film of lubricant remains to prevent actual metal to metal contact.

Where both dust and high pressure must be encountered by the gears of the same machine, it is perfectly evident that trouble may arise in either case if the lubricant is so far lacking in the required properties as to function ineffectually. The problem is therefore to select such a lubricant as will, as far as possible, satisfy both conditions. Both cannot be ideally met, but it is entirely possible with care and judgment to obtain a product of sufficiently suitable viscosity to give adequate protection, especially if due regard is afterwards paid to the manner and frequency of application.



Courtesy of S. F. Bowser & Co. Inc.

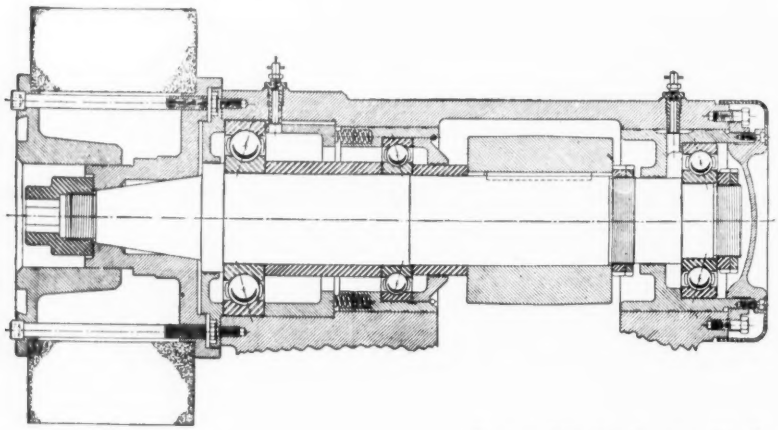
Fig. 6—Showing an oil filter installation in connection with a steam turbine. Flow of oil is shown by arrows as it passes to and from the turbine bearings via the filter located below the operating floor.

Lubricant Characteristics

Research and experimentation have proven that for such service the lubricant should be a homogeneous product, straight mineral in nature and so refined as to show no tendency towards reaction with acids or alkalis. It should furthermore be free from so-called fillers such as talc or rosin, etc. It should also be so impervious to weather exposure as to resist abnormal hardening, separation, cracking, disintegration, gumming or drying out; and it finally should not become so softened at normal temperatures of operation as to drip, run or tend to be thrown off by centrifugal force as the gears rotate, for this would decrease econ-

omy and lead to sloppy conditions around the mill.

A gear lubricant possessing these basic properties should show a naturally high ability to stick to wearing surfaces and it should be extremely serviceable and economical by virtue of its tendency to adhere so tenaciously to the gears, as to resist mixing with dust or other foreign matter. This would naturally lead to an increased period of service and render necessary application less frequent.



Courtesy of The New Departure Mfg. Co.

Fig. 7—The spindle for a heavy duty grinder. The application of grease lubricated ball bearings to such equipment insures dependability and freedom from lubricating problems under high speed operation.

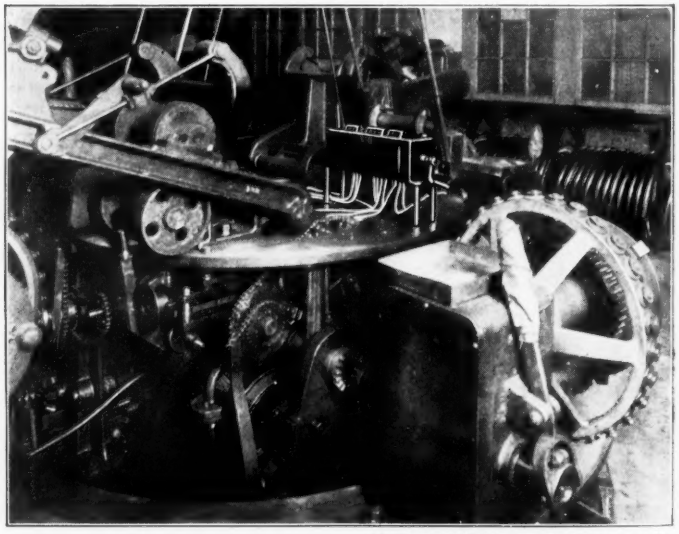
AIR COMPRESSOR OPERATION

The fact that efficient air compressor operation is decidedly dependent upon clean air and effective lubrication renders discussion of such equipment also of vital importance. Air compressor explosions or failures in after-coolers or any of the connecting lines are chiefly due to accumulation of deposits which restrict the free passage of the air and lead to abnormal temperatures by reason of frictional resistance.

Deposits of this nature may result from continued usage of lubricating oils of high carbon content. They are more liable, however, to be caused by entry of dust along with the air which is compressed. Were such foreign matter able to pass through with the air the result would not be as serious. There will be tendency, however, for it to remain in the system, especially where lubricating oil is used to any excess, to result in gummy deposits around valves, in cylinder clearances, in inter-coolers, after-coolers and air lines.

It is safe to say that all air for compressor service will carry an appreciable amount of fine abrasive dust. The nature of this latter, will, of course, depend upon the elevation and location of the installation. In flat, suburban or farming districts where road traffic may be fairly heavy, winds prevalent, etc., the resultant dust which will be bound to occur will probably be of an earthly or siliceous nature. In contrast the dust content of the average air in mining or smelting localities, or industrial centers will include ash, coal dust or more or less mineral matter, bat of course all in very finely pulverized condition.

In consequence steps should be taken wherever possible to protect air compressor equipment and insure effective lubrication by properly filtering the air prior to its being drawn into the system. This means the installation of adequate filtering equipment at the intake.



Courtesy of McCord Radiator & Mfg. Co.

Fig. 8—The mechanical force feed oiler applied to rubber machine lubrication. Positive yet economical application of lubricants is decidedly essential where equipment is to function in the presence of acid fumes, sulphur or dust.

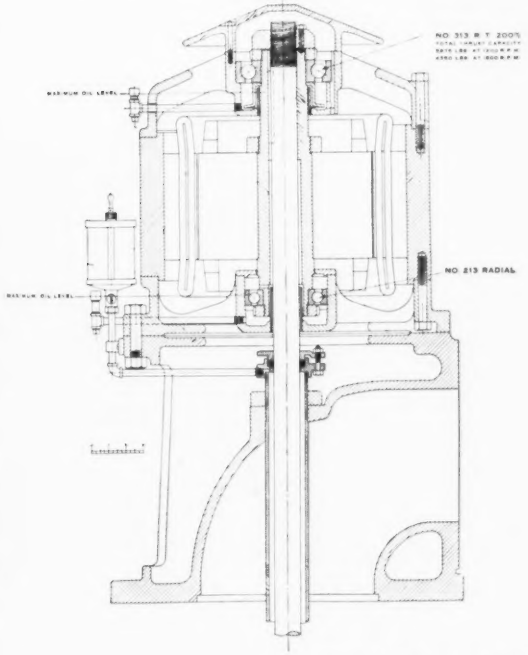
Carbon Deposits

Inasmuch as the lubricating oil may cause, or lead to deposits of more or less intensity, de-

pending upon its carbon content, the amount used and the operating conditions involved, more discussion in the solution of this problem will be of interest.

Deposits of carbon plus dirt on the valves or in the discharge lines of an air compressor are to a certain extent, caused by decomposition of the oil. It is an accepted fact that mineral lubricating oils, regardless of their base or nature, will decompose to volatile products and carbon when subjected to hot air under pressure. The extent of this decomposition of course depends on the length of time the oil is exposed to such heat. Naturally, also it will follow that the oil which remains in the compressor cylinder or on the discharge valves the longest, will form the greatest amount of carbon.

On the other hand, analysis of numerous so-called carbon deposits has proven to them to consist more of dirt than of carbon, the whole being held together by gummy matter from decomposed oil. For this reason a compressor oil having a wide range of distillation, high end point, or too great a viscosity is objectionable,

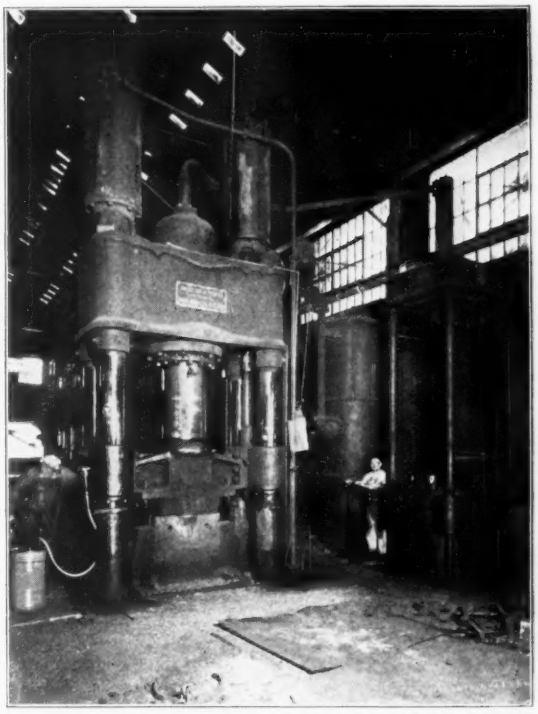


Courtesy of Marlin-Rockwell Corp.

Fig. 9—The vertical motor of a deep well pump. Lubrication of the top bearing is effected through a circulating oiling system in the bearing housing, a pump being provided for lifting the oil up from the reservoir below the bearing. The bottom bearing runs submerged in oil.

inasmuch as, instead of vaporizing cleanly, it breaks down as has been mentioned above, becoming sticky and collecting dirt brought in by the air. The slower the breaking down process, or the greater the volume of oil involved, the more carbon will ultimately be formed.

Pale filtered oils, properly refined, show but little tendency towards direct carbonization or the collection of carbonaceous matter. Furthermore, any such direct carbon that may be formed through excessive use, is of a light, fluffy nature. Carbon deposits formed from improperly refined or unsuitable oils, on the other hand, are often of a hard, flinty nature. Any oil, however, will accumulate dust if the air is dirty.



Courtesy of The John P. Stetson Co.

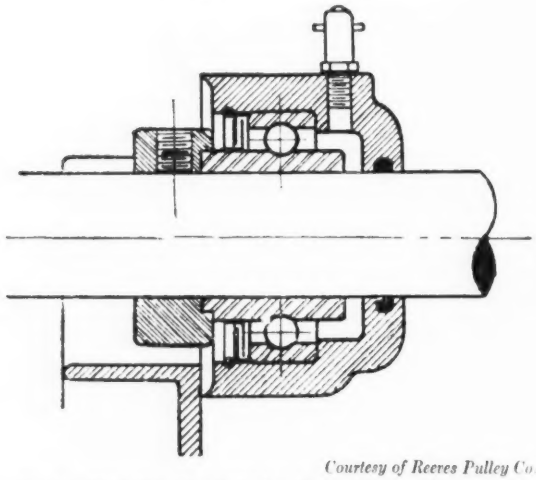
Fig. 10—Grease lubrication of an hydraulic press. Where high pressures are involved lubrication by means of a heavy grease under adequate pressure to insure proper penetration will effectively protect the wearing elements.

Air Compressor Explosions

This matter of explosions is of the utmost importance to all who have to deal with air compressor operation and lubrication. Explosions occur due to accumulations of carbonaceous matter becoming heated to the point of combustion when abnormally high temperatures are involved due to leaky valves, either causing the metal to burn through and blow out, or bringing about the ignition of gaseous (oil and air) vapors which may have resulted from oil collections in pockets, etc. Localized vaporous accumulations of this nature will practically always become sufficiently condensed in time to form a "critical" or combustible mixture of air and oil vapor, requiring only intense heat or a spark from incandescent carbon to cause an explosion.

Three distinct factors, therefore, require consideration, i.e.:

1. The amount of oil used.
2. The extent to which carbon deposits or accumulations of dust, dirt and oil, etc., are involved, and



Courtesy of Reeves Pulley Co.

Fig. 11—The ball bearing frame box of a variable speed transmission. Note that grease lubrication is provided for by means of an Alemite fitting. Maintenance cost is thereby reduced and positive operation assured.

3. The generation of excess heat, due either to air leaks in the discharge or final stage of compression, especially at the time of "unloading," or increased velocity of flow through the lines.

Carbon deposits or "carbonaceous" matter in general, does not strictly denote pure carbon, or in other words, carbonized oil. In fact, the proportion of fixed carbon to volatile matter in many cases will be relatively low.

Silica, iron, copper and zinc have all been found present, proving that a considerable portion of any such deposits can therefore be regarded as consisting of substances which are either drawn in by the original charge of air, or abraded from the metallic parts of the system

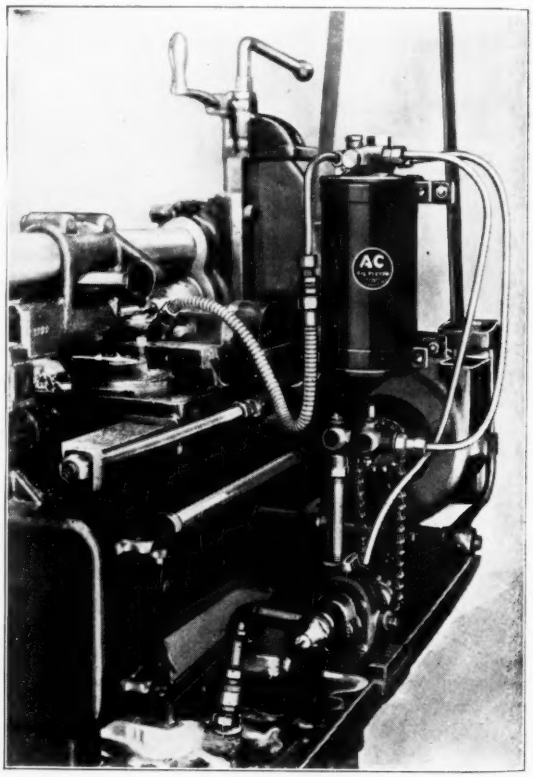
OIL ENGINES

Clean air is also important in oil engine operation, viz.: Air for scavenging and combustion should be as clean and free from abrasive foreign matter as possible. Of course this will be most important in the full Diesel engine where air is not only mixed with the fuel prior to combustion, but is also used to bring this about. Yet in the semi-Diesel, it is likewise of importance, for dirty air will preclude efficient operation by increasing deposits and perhaps causing scored cylinders, etc.

More detailed discussion of the reasons for this will be of interest. While all air will contain a certain amount of minute abrasive, foreign matter, of course in certain localities and in certain industries where oil engines are employed, this will be far more in evidence than in others.

The marine Diesel engine for example, will usually function on comparatively dust-free air, and therefore might not require any air filtration, whereas, a stationary engine operating in a stone working plant, would be a decidedly fit candidate for attention in this regard. Essentially, therefore, the oil engine operator will be confronted with the problem of determining the dust content of the air in his engine room.

In the counteraction and partial elimination of deposits and so-called carbonaceous matter in the cylinders, etc., of oil engines and oil engine air compressors, it is well to bear in mind that dust and other foreign matter carried in with the air is one of the chief promoters of these evils. In fact the amount of carbon developed in the normal operation of the average Diesel engine using medium gravity fuel and



Courtesy of A. C. Spark Plug Co.

Fig. 12—Machine tool operation can be materially improved by use of clean oil. The oil filter will assure this, and prevent metallic cuttings from passing to bearings or gears.

high grade lubricating oil, will usually be practically negligible.

Solid Matter Objectionable

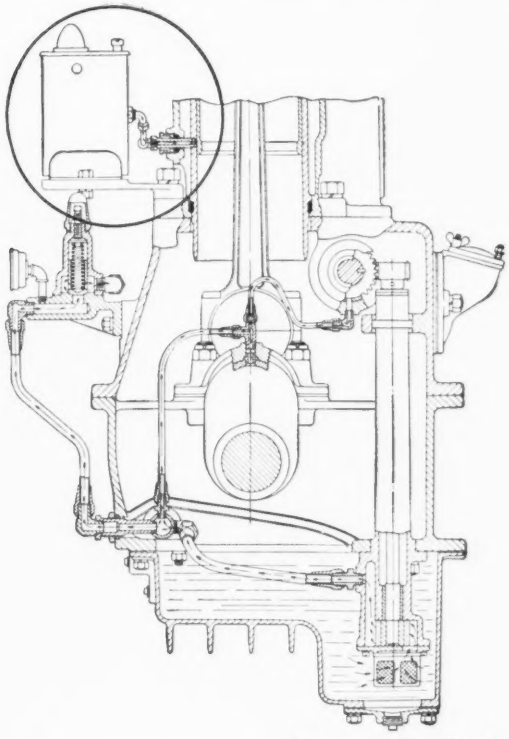
So it is with the solid, non-combustible matter that we are more distinctly concerned, espe-

cially, too, if the fuel as well as the air contains such impurities or is so injected that incomplete combustion takes place. Under such conditions a cementing medium would be developed or left as part of the fuel residue which would soon absorb any dust and dirt carried in with the air, and collect on the piston heads, the walls of the combustion chamber, and even around the rings. The use of an excess of lubricating oil would increase the percentage of potential gummy residue, and not only aid in the formation of deposits but also tend to seal the rings.

It is conceivable that dust and dirt might have a certain catalytic action in this regard, for as is true in the automobile engine, cylinder deposits are noticeably increased when dirty air is used. In other words, the dirt and dust carried in by the air prevent the burning out of true carbonaceous residues during operation.

INTRICACIES OF OPERATION

There is another factor which may also often be the basic cause of lubricating problems, viz.:



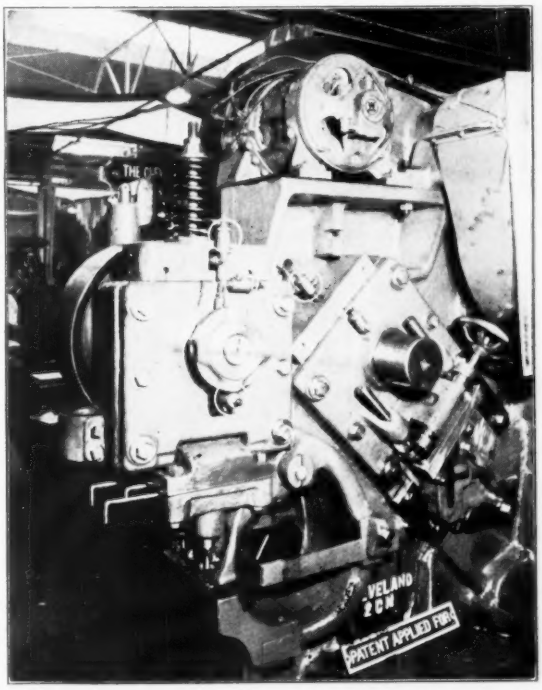
Courtesy of Madison-Kipp Corp.

Fig. 13—Circulating oiling system for bearing lubrication, and fresh oiling of cylinders of a tractor engine. Oil seal is thereby effectively maintained and wear reduced as far as possible Cylinders are served by a force-feed lubricator.

the intricacy of operation to which the lubricant is subjected. In many instances, the fragile nature of the product and the necessity of keeping it absolutely free from contamination by oil (especially where this latter may have become dust-laden) may often be conducive to considerable machine trouble through overcautiousness.

The Knitting Machine

A good example of this would be the modern knitting machine. As a general rule a specially



Courtesy of Gun-Fil Corporation

Fig. 14—Showing method of lubricating the bearings of a metal working machine by spring pressure grease cups. Constant pressure on the lubricant feed is a decided factor in maintenance of the requisite degree of lubrication where bearings are subjected to high operating pressures.

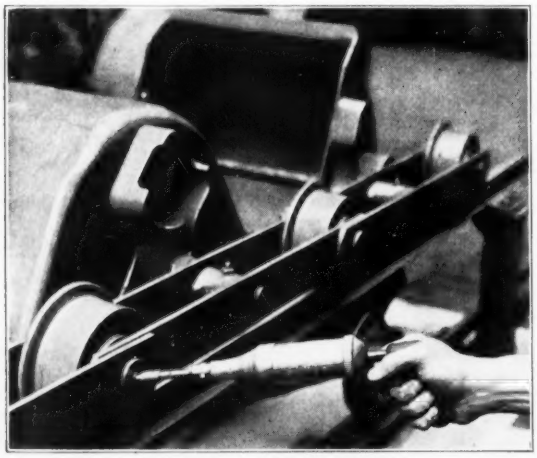
refined, stainless textile oil is recommended for all parts from which oil might drip or be thrown to cause discoloration of the fabrics. Rigid instructions are also frequently laid down as to the rate and extent to which such equipment should be lubricated. Unfortunately in the interests of fabric or yarn protection, this may often be carried too far, and lubrication actually neglected.

Now a knitting machine is a decidedly intricate device and although it does not require much oiling its wearing elements certainly will not stand neglect. But "oil spots" are a veritable crime and where an operator may have been called down for same, even though the fault may not be entirely his, he will surreptitiously skimp on future lubrication to make sure of his own job, even though the machine may ultimately suffer. Usually this will not be found out immediately and all will go well with a maximum of first grade product, until perhaps one day, the machine will suddenly "go out" simply by reason of overwear and lack of lubrication. The more finely designed

and constructed parts will usually be the first to go and the most costly to renew.

The Management Must Study Such Conditions

The solution of such problems must be developed by the management. It will require



Courtesy of The Bassick Mfg. Co.

Fig. 15—Lubricating the bearings of a bucket type conveyor by means of a pressure grease gun, via flush type fittings. Protection of bearings is thereby assured, with the least possibility of broken or damaged grease fittings.

study of their machine lubrication requirements, and the habits and nature of their operators. To call an employee "on the carpet" and lay down the law is no assurance that he will strive to remedy his own bad habits. Usually it will only lead to ultimate damage of machinery.

High grade lubricants will, however, go a long way towards keeping peace in an "industrial family," but they cannot be expected to be the absolute solution of any problem. Their limitations must be understood by the management, and the potential difficulties which may arise from their misusage must be appreciated. In other words, any lubricant to be satisfactory must be refined to develop characteristics which are required by the operating conditions involved.

OTHER PREVALENT PROBLEMS

There will, of course, be cases in addition to the above, where difficulties in lubrication will be traceable to other sources than improper selection, careless storage or handling, or unsuitable means of application.

In the Silk Mill

For example, in the silk dye house, pure water is a most essential factor both in the preparation of chemical solutions as well as for washing purposes. For this reason, where there is any doubt as to the purity of surface waters available, it is generally considered advisable to resort to wells. The most suitable method of obtaining such water in adequate quantities at all times is to blow the wells with compressed air.

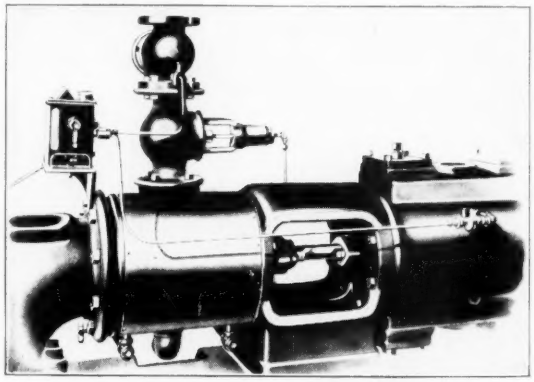
But here is where a problem traceable to lubrication may result. Oftentimes if an excess of lubricant is fed to the air cylinders of the compressors quite a considerable amount of oil will be carried by the air to be ultimately taken up by the water.

In many stages of the dyeing or bleaching process this oil might prove ruinous to the silk, or at least it would so contaminate the fibres that considerable additional time and expense would be necessary to remove it by boiling or cooking. In consequence the dye house engineer must watch his compressor lubrication quite as carefully as he would watch the oiling of his dyeing reels, etc. Both involve the utmost care in the handling of lubricants.

Presence of Oil in Exhaust Steam

Another prevalent cause of trouble in some industrial plants will be the presence of oil in exhaust steam, when the latter is destined to be used for certain process heating purposes in open containers.

For instance, in many chemical plants and textile dye-houses water is heated by leading the exhaust steam into an open heater tank



Courtesy of Ingersoll Rand Co.

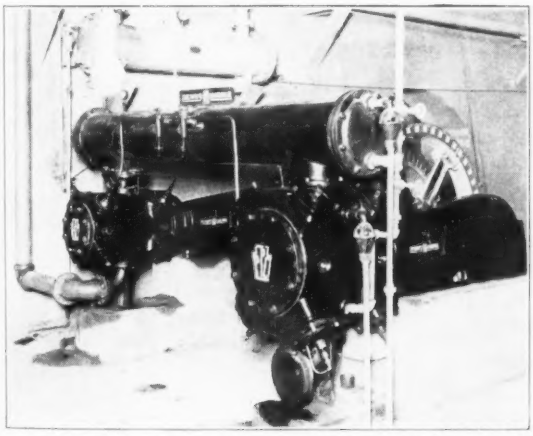
Fig. 16—The force feed oiler used to serve a horizontal air compressor. Here the one lubricator is used for both air and steam cylinders via suitable piping as shown. A two-compartment lubricator should be used due to the fact that two distinct grades of oil are required. The utmost care should be observed in order that the right oil always will be delivered to the right place.

such as a hot well. Where steam cylinder oils have been used containing a certain percentage of fixed oils or animal compound as will be necessary in the average industrial power plant operating steam engines or pumps, there will always be an appreciable amount of the lubri-

cant present in the exhaust steam. Furthermore, if this latter is not passed through a suitable oil separator or grease extractor, the oil content will most surely be carried to the heater.

Frequently, where but a slight oil content is involved any detriments can be guarded against by drawing the necessary hot water from near the bottom of the tank. Or, perhaps this oil would only be detrimental in relatively large amounts, according to the purpose involved in heating and the products which may be affected.

Nevertheless, it can be appreciated that there would most assuredly be an element of potential trouble always present, so here again the engineer must observe every care not only in the regulation of the draw-off valve from the heater, but in keeping oil separators in proper working condition. Primarily, however, he should use only such an amount of cylinder oil as is absolutely necessary for efficient cylinder lubrication of his pumps, engines or other reciprocating steam driven equipment. Especially in the use of hydrostatic lubricators or steam chest oil cups is there considerable danger of quite an excess of oil being fed to the cylinders, for such equipment is frequently incapable of accurate control or adjustment, and is furthermore sometimes neglected.

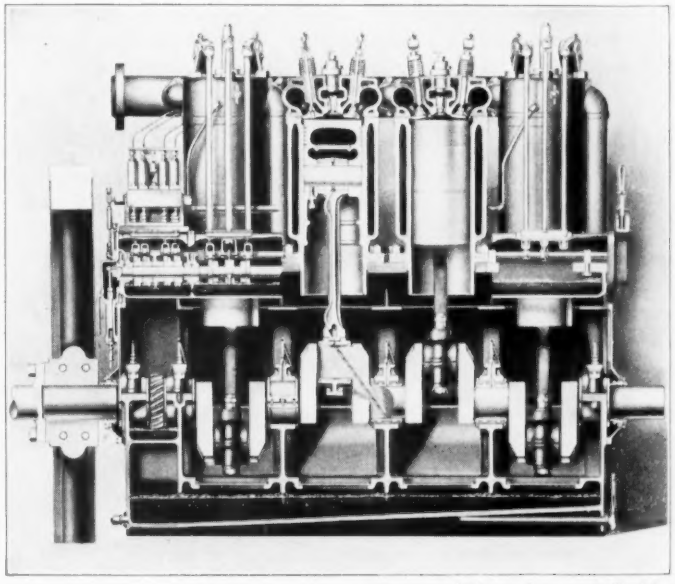


Courtesy of Pennsylvania Pump and Compressor Co.

Fig. 17—Air compressor lubrication in the cement plant is of decided importance due to the amount of dust present, and the possibility of it contaminating compressor oils, or abrading the surfaces of cylinders or bearings. As a result every care must be taken to protect the entire installation by proper selection, storage and handling of lubricants.

Mechanical Factors

In reciprocating steam engine operation there are still other factors that must be considered, which, even though not connected with cylinder lubrication, will nevertheless, often be attributed to this latter. For example, faulty operation such as knocking at the end of a stroke is a frequent excuse for assuming that lubrication is



Courtesy of Chicago Pneumatic Tool Co.

Fig. 18—Details of a four cylinder oil engine showing lubricating system. Full pressure lubrication from the crankcase via a geared pump prevails to all bearings. Cylinders in turn are oiled by the throw from the crank shaft.

insufficient. However, this is a mechanical reaction due entirely to improper adjustment such as continued keying up of the wrist and crank pins without allowing for the correspondingly increased length in the stroke of the piston rod. Or, the same occurrence may be due to loose piston or rod fittings, such as the rings, plates or bolts, etc.

Again, in a slide valve engine, if the steam valve is not properly set and excess exhaust lap is present, the cylinder pressure may sometimes be higher than the steam line pressure. As a consequence, the valve may tend to be partly lifted from its seat prior to admission to cause a knocking sound when it returns to position.

Other Indications of Trouble

A sound such as groaning, however, where coming from within the cylinders will indicate insufficient or improper lubrication. There are a number of factors which may tend to bring about such a condition. For example, should an inferior or inefficient type of lubricator be used it may oftentimes result in a stoppage of the oil flow because of plugged lines or pressure leaks.

In other instances, the selection of a cylinder oil with too little compound for the extent of moisture in the steam might result in the film

of lubricant being washed too readily from the cylinder walls to reduce protection of both the latter as well as the piston rings.

Again, where boiler compounds are used, the cylinder oil should be made from an unfiltered cylinder stock, rather than a filtered product, for it has been developed that filter treatment may lead to chemical reaction where the oil must come in contact with steam of an alkaline nature.

LUBRICATION SERVICE

Lubrication service through the medium of a competent lubricating engineer should be of inestimable value in this entire matter of attaining effective lubrication by the solution of lubricating problems. But the wrong impression of such service should never be gained. There are too many who are so short-sighted as to be prejudiced, holding the viewpoint that such service is merely cut-and-dried sales talk, to further the use of some particularly expensive lubricant which is on the market.

Such a program, however, is furthest from the ideas of every reputable concern in the oil industry as well as all dependable engineers. Their ideal is to give every client the true benefit of their experience with the various grades of lubricants adaptable to machinery such as his, to instruct him in the proper method of carrying out lubrication, and wherever necessary to recommend the installation of more efficient means of lubrication or methods of storage prior to usage.

To appreciate his problems and to tell him how to avoid them by the proper use of the right lubricant, is the real aim of lubrication service. It is reasonable to expect that the more receptive the management may be to such advice, the better will their plant probably operate.

In fact, to sum up, it amounts to a matter of having confidence in your lubrication engineer just as you would in your doctor, and by giving him adequate latitude to enable him to save you money in the long run, even though it may sometimes call for a slight addition to present costs of operation, or increase in capital investment where revision of a lubricating system may, for example, be advisable.

CONCLUSION

In order to emphasize the importance of the cost of lubrication, considerable care has been exercised in the selection of suitable illustrations for this issue. As a general rule it has been deemed advisable to confine these to means of effective lubrication, for if the means of lubrication is practicable and suited to the operating conditions, the possibility of subsequent difficulty in distribution of lubricants to the wearing elements will be decidedly reduced.

Practicable means of lubrication will furthermore, materially simplify the work of the lubricating engineer. In fact, with adequate means of application provided for, his efforts can be more nearly confined to study of operating conditions and the selection of the most suitable lubricants, thereby enhancing the value of his services.

This is a real value and should not be disregarded even at a period of eminently satisfactory operation. Too many contingencies are involved, any one of which, such as temperature fluctuation, etc., may develop a decided problem virtually overnight. Therefore, lubricating service should never be picked up and dropped at random. It should be a permanent factor throughout industrial and power plant operation.

Printed in U. S. A. by
EDGAR C. RUWE CO., INC.
72 Washington St., N. Y. C.